

lithium group, and that, in consequence of their lack of electric polarity and their inactivity they form, in a certain sense, a connecting-link between the two. It is curious, too, to notice that iodine, xenon, caesium and barium form the ends of their respective columns. It is, of course, not impossible that other elements may be discovered, possessing similar properties, and yet higher atomic weights than these; but as yet there is no clue to guide us where to search for them.

It is difficult, owing to the impossibility of effecting a complete separation of the inactive elements from each other, to do more than hazard a guess as to their relative amount in air. As they are easily separated from the other constituents of air, there is no doubt as to their total amount; air contains 0.937 parts of argon and its companions by volume in 100 parts. Perhaps the table below may be taken as affording some indication of their relative amounts. Air contains by volume:—

0.937 part of argon per hundred.
One or two parts of neon per hundred thousand.
One or two parts of helium per million.
About one part of krypton per million.
About one part of xenon per twenty million.

It is of course not impossible that xenon may contain an even smaller proportion of a still heavier gas; but it is unlikely. Sea-water sometimes contains a grain of gold per ton; that is one part in 15,180,000; a grain of xenon is contained in about four hundredweights of air.

The problems suggested by the periodic table are by no means solved by the discovery of these aerial gases; but something has been done to throw light upon one obscure corner of the field. The gap between the electro-positive and the electro-negative elements has been bridged.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PRESIDENT ROOSEVELT has definitely decided not to accept Mr. Carnegie's offer of ten million dollars in Steel Trust bonds for public educational purposes. The provision attached to the offer to the effect that the Government should hold the bonds for a term of years is regarded as being especially objectionable.

THE scheme for the establishment of a University of Liverpool is beginning to take definite shape. A report upon the subject, submitted to the Liverpool University Committee on Monday, stated that the capital invested in land, buildings, equipments and endowments at University College, Liverpool, is not much less than 500,000*l.* To realise the ideal of a modern University, efforts will be made to raise a further capital sum of 330,000*l.* and an additional annual income of 9000*l.* Of the capital sum, 130,000*l.* would be required for additional college land and buildings. The remaining 200,000*l.* would supply an endowment for the professorial chairs and lectureships most urgently needed, especially in modern languages, chemistry and applied science, including electrotechnics. The additional yearly income of 9000*l.* would be needed for maintenance of the various departments, scholarships, equipment of the library, &c. The committee hope that the 330,000*l.* will be provided by gifts of Liverpool citizens and others interested in the highest education; and the additional income will be provided by increased grants from the Treasury, an annual grant from the Liverpool City Council, which, as it helped to create the college, will, it is hoped, give its aid in the establishment and maintenance of a Liverpool University.

THE annual conferences of science teachers arranged by the London Technical Education Board will be held on Thursday, January 9, and Friday, January 10, 1902, at the South-Western Polytechnic, Manresa Road, Chelsea, S.W. There will be four meetings, successively presided over by Mr. T. A. Organ, Sir Henry Roscoe, F.R.S., Principal Rücker, F.R.S., and the Countess of Warwick. The addresses to be delivered are as follows:—"Teaching of Hygiene," Miss Alice Ravenhill; "Mental School Hygiene," Dr. Francis Warner; "Teaching of Natural History," Mr. Frank E. Beddard, F.R.S.; "Value of Natural History Collections for Teaching Purposes," Prof. W. R. Bottomley; "American Systems of Nature Study," Mr. R. Hedger-Wallace; "Nature Study in Schools," Mr. D. Houston; "Technical Education in Rural Secondary Schools," Mr. E. E. Hennessey; "Pioneer Work in Secondary and Technical Education in Rural Districts," Prof. R. Meldola, F.R.S.

A collection of home-made apparatus for science teaching in schools will be on view during the days of the conference. Applications for tickets of admission should be made to Dr. Kimmins, Park Lodge, Harrow-on-the-Hill, or to Mr. C. A. Buckmaster, 16, Heathfield Road, Mill Hill Park, W.

THE following resolutions passed by the committee of the Agricultural Education Association were confirmed at a general meeting of members held on Thursday last:—(1) That, if the Board of Agriculture retain their present educational work, it is essential that there shall be complete cooperation between that Board and the Board of Education on all educational matters specially affecting the agricultural classes. (2) That for purposes of agricultural education the country should be divided into districts, and such inspectors appointed as may be necessary. (3) That groups of counties, not yet affiliated to any collegiate centre, should be formed, each group being affiliated to some centre. (4) That, after due inquiry, reports should be issued dealing with the most appropriate forms of agricultural education for each county. (5) That permanent demonstration stations should be organised in each county or group of counties. (6) That official information bearing upon all matters of agricultural interest, whether educational or otherwise, should be distributed to the public free of cost. (7) That to carry out the above objects it is essential that larger funds be placed at the disposal of the Board of Agriculture for educational purposes. (8) That the work of the Board of Agriculture might be facilitated by the appointment of a consultative committee on the analogy of those of the Board of Education and of the Department of Agriculture in Ireland. (9) That copies of the above resolutions be sent to the Presidents of the Boards of Education and of Agriculture.

SIR WILLIAM ABNEY, K.C.B., opened the new science buildings in connection with Watford endowed schools on Thursday last. The new rooms comprise a lecture room, a physics laboratory, museum and balance room, a preparation room and a dark room, which, with the chemical laboratory (28 ft. by 24 ft.), erected in 1892, form a serviceable set of rooms, specially designed for science teaching. The cost of the additions has been about 2000*l.*, and the sum previously expended on science buildings about 1000*l.* In the course of his remarks at the opening ceremony, Sir William Abney said he did not wish any of them to think that whilst they in the secondary branch of the Board of Education encouraged science in every possible way they discouraged the other branches of education which were given at the same time. One of the reasons for starting the schools of science on their present basis was to insure that any boy or girl going through a course of science should at the same time be educated in literary work, which was so necessary in education. Of course there was a great deal of difference between mere instruction and education. The utilitarianism of education was of minor importance; the great thing was education itself. If they could make the instruction that was given useful so much the better. In the old days the only possible means of education was by literary work, classics and so on. There was no science, and therefore they could not say that a boy or girl was to be educated in scientific methods; but he was certain those who founded schools like those at Watford were so alive to the necessity of education that they would be equally alive to the necessity of education in modern methods.

WE are glad to see that the subject of the coordination of the work of the Polytechnic Institutions of London with that of the Colleges was touched upon by Principal Rücker in the course of an address delivered at the South-Western Polytechnic, Chelsea, on Friday last. A place has been found for the Polytechnics in the reconstituted University of London, but their position is not clearly understood, and the direction in which their work may be usefully developed has not been sufficiently described. The Institutions provide opportunities for study and research, and the buildings, with those of other Colleges, help to make the University of London something more than a name. The standard of Polytechnic instruction is perhaps not so high in some cases as might be desired, but it can be raised in the course of time, and the efforts of friends of the University should be directed to this end. It is far better to make the best use of existing educational material than to neglect it. As Principal Rücker remarked, the endeavours that are being made are scattered, and the object of the University is to focus them into one strong effort in order that they may advance as a well-ordered army towards one common end. If that can be

achieved—if the Colleges and Polytechnics can be connected into one great educational machine—something worthy of the metropolis and of the Empire might be accomplished. The aims of the University of London will be, above all, practical. There should be great technical institutions which would prepare men for their work in life, and all who came within the range of the University should acquire something beyond the mere knowledge which enables them to take their parts in life.

THE connection between scientific knowledge and industrial progress was referred to by Mr. Balfour on Thursday last, in distributing the prizes and certificates to students at the Goldsmiths' Institute (see p. 136). He remarked, in the course of his address:—"I am but little qualified to speak by personal investigation or experience of the work of institutions like this; but there is one part of their labours in which I have always felt the deepest sympathy, from a strong sense of its transcendent importance—I mean the teaching which gives a sound and thorough scientific training to those who are engaged in any one of the many pursuits which have a genuine scientific knowledge at their base. I am quite sure that, if we were to gauge the deficiencies of British education as compared, let us say, with German education, they would be found more striking in this branch of education than almost in any other. I am strongly convinced that not only is the necessity of a thorough scientific training great at the present moment, but that the necessity is one which grows with every new discovery. There was a time when in reality theoretical scientific knowledge was wholly divorced from manufactures or any form of practical industry. That state of things has long passed away; and now the alliance between the most abstruse scientific investigations and the general manufacturing output of the country is becoming closer and closer. What was yesterday the curiosity of the laboratory will to-morrow be manufactured in the gross and exported from this country, or from other countries, to every quarter of the globe. And no mere surface knowledge, no mere acquaintance with the methods in fashion at a particular moment, can possibly replace that knowledge of principle which lies at the very root of all these discoveries, and which must be possessed by those who are to attain the greatest success, either as the guides and leaders of manufacturing industry or as the inventors who are to increase the sum of human happiness and health by the work of their brains." The Lord Chief Justice gave expression to similar views in an address delivered at the Rutlish Science School, Merton, on Monday. He remarked that there was not the smallest doubt that what was required in these days—not only in Great Britain, but throughout the British dominions—was a more accurate scientific teaching, a more practical scientific teaching. We were, at the present time, suffering from the fact that those in charge, not only of our commercial supremacy, but of our education, up to some ten or fifteen years ago, had not realised that other countries had discovered that the root of all successful commercial enterprise must be scientific knowledge and investigation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 21.—"Observations on the Physiology of the Cerebral Cortex of some of the Higher Apes." (Preliminary communication.) By A. S. F. Grünbaum, M.A., M.D. Cantab., M.R.C.P., and Prof. C. S. Sherrington, M.A., M.D., F.R.S.

Our experiments have been carried out on individuals representing the four species *Pithecius satyrus* (Orang), *Troglodytes gorilla* (Gorilla), *Troglodytes niger* (Chimpanzee), and *Troglodytes calvus* (Chimpanzee). The specimens so far have included ten adult individuals.

I. Method employed.

The method of excitation employed for the cortex has been unipolar faradisation, in the manner previously adopted by one of us (Sherrington, Roy. Soc. Proc., vol. lii., 1893) in examining the cortex cerebri for ocular reactions. This method allows of finer localisation than that possible with the double-point electrodes ordinarily used.

II. "Motor" (so-called) Area.

This area we find to include continuously the whole length of the precentral convolution. It also enters into the whole length

of the *sulcus centralis*, with the usual exception of its extreme lower tip and its extreme upper tip.

In all the animals examined, we have found the "motor" area not to at any point extend behind *sulcus centralis*.

On the mesial surface of the hemisphere the "motor" area has extended less far down than was expected. It has not extended to the calloso-marginal fissure. Certain areas near that fissure have yielded us movements, e.g. of shoulder, body, wrist and fingers; but we hesitate, for reasons to be given in a fuller communication, to class those with those of the "motor" area proper.

We have found the precentral convolution excitable over its free width, and continuously round, into and to the bottom of the *sulcus centralis*. The "motor" area extends also into the depth of other fissures besides the Rolandic, as can be described in a fuller communication than the present. The hidden part of the excitable area probably equals, perhaps exceeds in extent, that contributing to the free surface of the hemisphere. We have in some individuals found the deeper part of the posterior wall of the *sulcus centralis* to contribute to the "motor" area.

In the "motor" area we have found localised, besides very numerous other actions, certain movements of the ear, nostril, palate, movements of sucking, of mastication, of the vocal cords, of the chest wall, of the abdominal wall, of the pelvic floor, of the anal orifice and of the vaginal orifice.

We find the arrangement of the representation of various regions of the musculature follow the segmental sequence of the

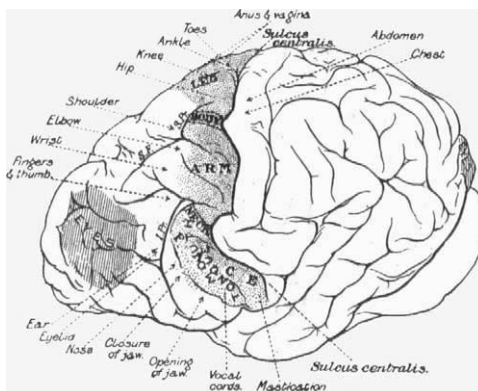


FIG. 1.—Brain of a Chimpanzee (*Troglodytes niger*). The extent of the "motor" area on the free surface of the hemisphere is indicated by the black stippling, which extends back to the *sulcus centralis*. There exists much overlapping of the areas and of their subdivisions which the diagram does not attempt to indicate. S.F. = superior frontal sulcus. S.Pr. = superior precentral sulcus. I.Pr. = inferior precentral sulcus.

cranio-spinal nerve-series to a very remarkable extent. The accompanying figure indicates better than can a verbal description the degree of adherence to this sequence.

We do not find that for the anthropoid brain the exciting current for the "motor" cortex requires to be extremely strong. "Epilepsy" is easily evoked from the cortex of the anthropoids.

Our experiments show that the *sulci* in the region of cortex dealt with can in no sense be considered to signify physiological boundaries. Further, the variation of the *sulci* in these higher brains is so great from individual to individual that, as our observations show, they prove but precarious, even fallacious, landmarks to the details of the true topography of the cortex.

Extirpation of the hand area by itself has been followed by severe paresis of the hand, the hand being for a few days practically useless and seemingly "powerless." In a few weeks use and "power" were remarkably regained in the hand, so that it was once more used for climbing, &c. The animal ultimately not unfrequently fed itself with fruit, making use of that hand alone. Even small ablations in the precentral gyrus have led to severe though quickly diminishing pareses. On the other hand, ablations of even large portions of postcentral gyrus have not given any even transient paresis.

III. Other Regions of Cortex.

Our observations indicate that the frontal region, yielding conjugate deviation of the eyeballs, presents such marked